

**RECORD OF DECISION AMENDMENT 2
(Interim Remedy)
PCB AREAS OPERABLE UNIT
SANGAMO ELECTRIC DUMP/CRAB ORCHARD NATIONAL
WILDLIFE REFUGE SUPERFUND SITE
CARTERVILLE, ILLINOIS**

August 2014

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
CHICAGO, ILLINOIS**

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Figure 1 Crab Orchard National Wildlife Refuge Location Map

Figure 2 Locations of Groundwater Plumes 1, 2, and 3

Figure 3 Soil Mixing

Appendix A Responsiveness Summary

**Declaration for the Record of Decision Amendment 2
(Interim Remedy)
PCB Areas Operable Unit
Crab Orchard National Wildlife Refuge Superfund Site**

A. SITE NAME AND LOCATION

Sangamo Electric Dump/Crab Orchard National Wildlife Refuge (USDOJ)
Carterville, Illinois (EPA ID: IL8143609487)

B. STATEMENT OF BASIS AND PURPOSE

This decision document amends United States Environmental Protection Agency's (U.S. EPA's) selected interim remedy for contaminated groundwater at the PCB Areas Operable Unit (PCB OU) within the Sangamo Dump/Crab Orchard National Wildlife Refuge Superfund Site (Site), which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this Site. The State of Illinois concurs with the revised interim remedy identified in this amendment. This amendment will become part of the Administrative Record file to comply with NCP § 300.825(a)(2).

C. ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in the August 1, 1990, Record of Decision (ROD) and the June 23, 2000, Explanation of Significant Differences (ESD) for the PCB OU, as modified by this ROD Amendment, may present an imminent and substantial endangerment to public health, welfare, or the environment.

D. DESCRIPTION OF THE SELECTED REMEDY

Overall Site Cleanup Strategy

The Crab Orchard National Wildlife Refuge (Refuge) is currently divided into seven Operable Units (OUs). These OUs are:

- Metals Areas (Metals) OU
- PCB OU
- Explosives/Munitions Manufacturing Areas (EMMA) OU
- Miscellaneous Areas (MISCA) OU
- Water Towers OU
- Additional and Uncharacterized Sites (AUS) OU
- Lake Monitoring OU

The OUs are in various phases of cleanup: investigation, remediation, and long-term monitoring. Separate RODs were signed for the Metals OU, PCB OU, and the EMMA OU, on March 30, 1990, August 1, 1990, and February 19, 1997, respectively. A ROD for Site 14 of the MISCA OU was signed on October 30, 2001. Another ROD for Site 36 and other sites within the MISCA OU was signed on September 12, 2002. Separate Explanations of Significant Differences (ESD) were signed for the EMMA OU and the PCB OU on January 11, 2000, and June 23, 2000, respectively. A ROD Amendment to address groundwater contamination at Plumes 1 and 3 within the PCB OU was signed on August 7, 2007.

Remedial and Removal activities are complete for the Metals OU, EMMA OU, Water Towers OUs, and Site 14 and Site 36 of the MISCA OU. Long-term monitoring is being conducted for the Metals OU and the EMMA OU. Remedial action to clean up PCB-contaminated soil and sediment at the PCB OU was completed in 1997. In 2004, 2009, and 2012, further remedial actions were also conducted within the PCB OU to remove additional PCB-contaminated soil in the Center Swale drainage area, Tree Stand Area, the 1960s Ditch and other areas within the PCB OU. Cleanup activities required under the 2007 ROD Amendment for the PCB OU to address groundwater contamination at Plumes 1 and 3 were completed in 2012. The AUS OU remedial investigation and feasibility study is in progress. The Preliminary Screening Assessment for the Lake Monitoring OU was completed on October 9, 2001.

Addressing Principal Threats at the PCB OU

This ROD Amendment modifies the previously selected remedy for chlorinated volatile organic compound (CVOC) contaminated groundwater for Plume 2 within the PCB OU of the Crab Orchard Site. More specifically, this amendment modifies the cleanup technology selected in the June 23, 2000, ESD for the PCB OU. The 2000 ESD specified multiphase extraction (MPE) with phytoremediation and monitored natural attenuation as the groundwater remedy to bring the groundwater to drinking water standards. This ROD amendment does not affect the PCB OU soils remedy and other requirements specified in the August 1, 1990, PCB OU ROD. This ROD amendment also does not affect the 2007 ROD Amendment to address groundwater at Plumes 1 and 3 within the PCB OU.

There are three major groundwater plumes at Sites 32/33 of the PCB OU, identified as follows:

- 1. Groundwater Plume near Building I-1-23 (Plume 1)**
- 2. Groundwater Plume near Buildings I-1-2/I-1-3 (Plume 2)**
- 3. Groundwater Plume beneath the Area 9 Repository (Plume 3)**

The August 2007 ROD Amendment addressed groundwater contamination for Plumes 1 and 3. This Amendment to the ROD and ESD focuses on contamination source removal and groundwater cleanup at Plume 2 only.

The selected interim remedy utilizes soil mixing with Zero Valent Iron to treat trichloroethylene (TCE) -contaminated soil and groundwater. The source material identified as the principal threat

is TCE and CVOC contaminated material above and below the groundwater table. It is an interim remedy because, as explained in further detail below, it does not provide cleanup of the entire 72-acres of contaminated groundwater but focuses on cleanup of the areas with the highest TCE and CVOC concentrations. A final remedy will be determined following implementation of this ROD Amendment and development of data to support the final remedy for the entirety of Plume 2.

Major Components of the Revised Remedy

The major components of the revised interim remedy for Plume 2 are:

- Soil mixing with Zero Valent Iron
- Short-Term Monitoring (STM) to evaluate the effectiveness of the interim remedy
- Institutional Controls

E. ROD AMENDMENT DATA CERTIFICATION CHECK LIST

The following information is included in the Decision Summary of the ROD Amendment. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern (Section IX/Pages 14- 15).
- Past and current site risk (Section XI/Page 15).
- Cleanup levels established for chemicals of concern (Section XII/Page 16).
- How source materials constituting principal threats are addressed (Section XVI/Page 25).
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater. (Section X/Page 15).
- Potential land and groundwater use that will be available at the site as result of the selected interim remedy (Section XVI/Page 25).
- Estimated capital, annual operation and maintenance (O&M), total present worth cost estimates, discount rate, and the number of years over which the remedy cost estimates are projected. (Section XV/Page 25).
- Key factors that led to this ROD Amendment (Section VI/Page 8).

F. STATUTORY DETERMINATIONS

The revised interim remedy is protective of human health and the environment in the short term and is intended to provide adequate protection until a final ROD is signed, complies with Federal and State requirements that are applicable or relevant and appropriate for this limited-scope action, and is cost effective.

This interim action utilizes treatment and supports the statutory mandate for permanent solutions and treatment technologies to the maximum extent practicable.

The revised interim remedy for Plume 2 also satisfies the statutory preference for treatment which permanently and significantly reduces the volume, toxicity, or mobility of the hazardous substances as a principal element of the remedy.

Because the remedies from the 1990 ROD and this ROD Amendment will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that do not allow for unlimited use and unrestricted exposure, statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.



Assistant Secretary, Policy, Management,
and Budget
Department of the Interior

7/31/14

Date



Richard C. Karl, Director
Superfund Division
U.S. EPA Region 5

8-29-14

Date

Decision Summary
Record of Decision Amendment 2 (Interim Remedy)
PCB Areas Operable Unit
Sangamo Electric Dump/Crab Orchard National Wildlife Refuge
Superfund Site (USDOJ)
Carterville, Illinois

I. Site Name, Location, and Brief Description

The Sangamo Electric Dump/Crab Orchard National Wildlife Refuge (USDOJ) Superfund Site (Site) (EPA ID# IL8143609487) is located near Marion, Illinois, (Figure 1) primarily within Williamson County, extending into Jackson and Union Counties in southern Illinois. The Crab Orchard National Wildlife Refuge (the Refuge) consists of approximately 43,500 acres of multiple-use land. The Refuge is used as wildlife refuge and also for recreational, agricultural, and industrial purposes. The Refuge is owned by the U.S. government and currently is administered by the U.S. Fish and Wildlife Service (FWS), a bureau of the Department of the Interior (DOI).

II. Site History and Contamination Problems at the PCB Areas Operable Unit

While presently administered by FWS, the Department of Defense (DOD) administered the property during the World War II era in the 1940s. During the DOD administration, portions of the Refuge were leased to industrial tenants, primarily for the purpose of munitions and explosives manufacturing. In 1947, Congress directed the DOD to transfer the property to the DOI. Congress, in passing the law that created the Crab Orchard National Wildlife Refuge, mandated a continuing industrial presence on the Refuge property. While the principal industry at the Refuge was production of explosives, several other industries including Sangamo Weston, Inc., which manufactured capacitors containing polychlorinated biphenyls (PCBs), moved into the Refuge to occupy many of the buildings formerly used by the wartime industries.

Beginning in the late 1970s, DOI, U.S. EPA, and Illinois EPA conducted site investigations that indicated the presence of PCBs, lead, and cadmium in soils within the eastern portions of the Refuge. The Crab Orchard National Wildlife Refuge site was proposed for the National Priorities List (NPL) in 1984 and finalized on the NPL in July 1987. In 1989, a Remedial Investigation/Feasibility Study (RI/FS) Report was completed by FWS and Sangamo Weston, Inc.

During the RI/FS, thirty-three different study sites within the Refuge were investigated. The RI concluded that four of the sites needed remediation because of the presence of PCBs, lead, and cadmium, and that three other sites needed remediation due to the presence of heavy metals such as lead, cadmium, and chromium. U.S. EPA grouped these study sites into two separate operable units, the Metals Areas Operable Unit and the PCB Areas Operable Unit (PCB OU). The Metals Areas OU included the three study sites which contained heavy metals contamination. The PCB OU included the remaining four study sites that were contaminated with PCBs, lead, and

cadmium. These four sites are the Job Corps Landfill (Site 17), the Water Tower Landfill (Site 28), the Area 9 Landfill (Site 32), and the Area 9 Building Complex (Site 33). In August 1990 U.S. EPA issued a ROD that documented selection of the remedial action for the PCB OU. In May 1991 a Consent Decree was signed between U.S. EPA, DOI, and Schlumberger Industries Inc. (Schlumberger), a successor corporation to Sangamo Weston, Inc. Under the terms of the Consent Decree, Schlumberger agreed to perform the cleanup set out in the PCB OU ROD.

In September 1991, U.S. EPA entered into a Federal Facilities Agreement (FFA) with the DOI, Illinois EPA, and the Department of the Army (DA) (collectively referred to as the FFA Parties). The general purpose of the FFA was to ensure that the environmental impacts associated with past and present activities at the Refuge were thoroughly investigated and appropriate remedial action taken, as necessary, to protect the public health, welfare and the environment. The PCB OU, one of seven OUs originally identified by the FFA Parties, is the focus of this ROD Amendment.

During the initial soil cleanup activities, groundwater monitoring conducted by Schlumberger at the PCB OU detected TCE and other chlorinated solvents at levels above their respective drinking water standards. In June 2000, U.S. EPA issued an ESD to address the TCE-contaminated groundwater at the PCB OU. This ROD Amendment describes the changes to the cleanup action required in the June 2000 ESD.

The U.S. EPA is the lead agency for implementing the cleanup activities required at the PCB OU, including the activities required in the ROD, ESD, and this amendment for the PCB OU. DOI and the Illinois EPA are the support agencies at the PCB OU.

More information on the Site History and contamination problems at other operable units are provided in the following documents:

Metals OU ROD (March 30, 1990);
PCB OU ROD (August 1990);
EMMA OU ROD (February 1997);
EMMA OU ESD January 2000;
PCB OU ESD (June 2000);
MISCA OU - Site 14 ROD (October 2001);
MISCA OU - Site 36 ROD (September 2002); and
PCB OU ROD Amendment for Plumes 1 and 3 (August 7, 2007).

III. Cleanup Remedy Selected in the Record of Decision (August 1990)

In the 1990 PCB OU ROD, the selected remedy included:

- 1) The excavation of contaminated soil and sediment;
- 2) Treatment of all excavated soil and sediment contaminated with PCBs in excess of established remediation goals using mobile incineration technology;

- 3) Stabilization/fixation of residues from incineration and non-incinerated soil and sediment contamination with metals (if determined to be Resource Conservation and Recovery Act of 1976 (RCRA) hazardous because of the metals leachability) to render them non-hazardous;
- 4) On-site disposal of non-hazardous treated material and untreated residues exceeding the cleanup targets in a landfill meeting the requirements of RCRA Subtitle D and 35 Illinois Administrative Code Part 807;
- 5) Backfilling, placement of low-permeability caps and closure of areas where contamination is below the excavation criteria or from where contaminated soil and sediment have been excavated; and,
- 6) Environmental monitoring and maintenance during and after remedial construction to ensure the effectiveness of the remedial action.

IV. Remediation Goals Specified in the Record of Decision (August 1990)

The 1990 PCB OU ROD required the four sites containing heavy metals and PCB contamination to be remediated to the following cleanup levels:

Soil and Sediment Remediation Goals

Lead to 450 milligrams per kilogram (mg/kg) dry soil,
Cadmium to 10 mg/kg dry soil,
PCBs in top one foot of soil to 1 mg/kg dry soil,
PCBs in soil below one foot depth to 25 mg/kg dry soil, and
PCBs in sediments to 0.5 mg/kg dry sediment.

The 1990 PCB OU ROD also required that the risk from all of the chemical contaminants present in the soil and sediment above naturally occurring background levels established for the Site not exceed an excess cancer risk of one in one million and not exceed concentrations determined to produce any non-cancer chronic health effects.

Groundwater Remediation Goals

Although the 1990 PCB OU ROD, in a discussion of Site 33, Area 9 Building Complex, reported that TCE groundwater contamination was detected in one well at 906 micrograms per liter (µg/L), that ROD did not require groundwater remediation. Nor did the 1990 PCB OU ROD formally identify federal or any more stringent State applicable or relevant and appropriate requirements (ARARs) for the groundwater cleanup. Removal of the contaminated surface soils was expected to control the groundwater contamination. The 1990 PCB OU ROD did however require monitoring of the groundwater at each of the remediated sites during and after construction of the remedial action. The 1990 PCB OU ROD stated that the purpose of the monitoring was to ensure that, after completion of the remediation of the contaminated soils and sediments, the remaining risk from all of the contaminants in the groundwater (measured at the

source of the contamination) above naturally occurring background levels did not exceed any excess cancer risk or any standard. The 1990 PCB OU ROD also stated that:

“If, at any time, groundwater at the contaminated sites exceeds a 10^{-6} cumulative lifetime cancer risk, or Maximum Contaminant Levels (MCLs) for carcinogens, whichever is more stringent; and MCLs, Maximum Contaminant Level Goals (MCLGs), or a hazard index of 1.0 for noncarcinogens; whichever is more stringent, additional remedial work as determined by U.S. EPA, shall be performed.”

Surface Water Remediation Goals

The 1990 PCB OU ROD provides that the surface water in Area 9 will be monitored during and after construction of the remedial action. The results would be evaluated to ensure that after completion of the remedial action for the contaminated soils and sediments, the cumulative risk from all of the contaminants in surface water above naturally occurring background levels established for the site shall not exceed any non-cancer risk of one in one million (10^{-6}) and shall not exceed any non-cancer chronic health effects.

V. Explanation of Significant Differences (June 2000)

Groundwater monitoring conducted after implementation of the 1990 selected remedy indicated the presence of TCE and other chlorinated solvents at levels far exceeding their respective MCLs at Sites 32/33. Schlumberger conducted a groundwater investigation at Sites 32/33 in 1997 and 1998 and prepared a Groundwater Investigation (GWI) and Focused Feasibility Study Report (FFS) to address groundwater contamination. Although TCE contamination was known to exist at the time of the ROD, the GWI discovered levels of TCE in groundwater as high as 66,000 $\mu\text{g/L}$ or over 10,000 times the Safe Drinking Water Act MCL of 5 $\mu\text{g/L}$. In addition to the TCE contamination, other chlorinated volatile organic compounds (CVOCs) including tetrachloroethene (PCE), dichloroethene (DCE), and vinyl chloride were also discovered at levels above their respective MCLs. The GWI identified five separate known and potential CVOC source areas and associated groundwater plumes within the remediated sites 32/33. These areas include Building I-1-23, Building I-1-2/I-1-3, Building I-1-36A, Area 9 Repository, and an area south of the Repository. These five areas were identified as the source of three separate groundwater plumes. The Building I-1-23 and Building I-1-2/I-1-3 areas are the source of Plumes 1 and 2, respectively (Figure 2). The contaminated groundwater emanating from the area near the Repository, Building I-1-36A, and the area south of the Repository merges into a common plume known as Plume 3 (Figure 2).

In June 2000, U.S. EPA issued an ESD for the PCB OU selecting multiphase extraction (MPE) with limited phytoremediation and monitored natural attenuation as the appropriate remedial technology for groundwater remediation premised on source material removal. The remedy selected in the ESD was based on the assumption that the hydro-geological strata were similar in all of the source areas requiring remediation.

VI. Basis for Amending the 1990 PCB OU ROD

A pre-design investigation to further characterize the CVOC source areas at the PCB OU was conducted. The pre-design investigation results confirmed the presence of the three major CVOC-contaminated plumes in the groundwater. The investigation found that the hydro-geological strata near the Building I-1-23 source area consists of approximately 15 feet of an Upper Sand unit in between an Upper Clay and a Lower Clay unit, whereas near the Building I-1-2/I-1-3 source area, the Upper Sand unit between the Upper and Lower Clay units is either missing or discontinuous. The absence of the sand unit in the Building I-1-2/I-1-3 source area makes it difficult to achieve the remedial groundwater action objectives using the MPE technology without further enhancement. The physical differences between the separate CVOC source areas, and the anticipated difficulties in achieving the groundwater remedial objectives using MPE technology were sufficiently significant to warrant reevaluation of remedial alternatives for the separate primary source areas. The FFS Report (Revision 3) dated August 2004 reevaluated various alternatives to address the groundwater contamination at Plumes 1, 2, and 3. Consequently, amendment to the 1990 PCB OU ROD and June 2000 ESD was determined appropriate.

VII. 2007 ROD Amendment to address Groundwater Contamination at Plumes 1 & 3

In April 2006, U.S. EPA issued a Proposed Plan to modify the selected groundwater cleanup actions in the June 2000 ESD for the PCB OU. U.S. EPA signed an amendment to the 1990 PCB OU ROD and the 2000 PCB OU ESD on August 7, 2007. The 2007 PCB OU ROD Amendment addresses the following groundwater cleanup actions for Plumes 1 and 3 only.

- Plume 1 (Groundwater Plume near Building I-1-23) – Excavation and off-site disposal of CVOC-contaminated soil to 1 mg/kg CVOC contour in the Upper Clay unit, groundwater extraction and treatment in the Sand unit beneath the Upper Clay, and Phytoremediation.
- Plume 3 (Groundwater Plume formed from the sources at the Repository, Building I-1-36A, and south of the Repository) – Phytoremediation and Monitored Natural Attenuation.
- Institutional controls to prohibit the installation of potable water wells until the groundwater is restored to the drinking water standards at both Plume 1 and 3.

U.S. EPA initially considered electric resistive heating (ERH) and institutional controls as the preferred remedy for Plume 2 (Groundwater Plume near Building I-1-2/I-1-3). This remedy involved the use of electric current transmitted through the contaminated soil in the Upper Clay and the Upper Sand units, using a large number of metal electrodes to heat the groundwater in the vicinity of Buildings I-1-2/I-1-3 to the boiling point, and removal of the resulting steam and hot soil vapor using the vapor extraction system. However, DOI raised concerns relating to the safety of the employees working in the nearby buildings. They also raised concerns about potential detrimental effects of stray voltage from the ERH system on the highly explosive finished military ammunitions stored in Buildings I-1-2 and I-1-3. For these reasons, U.S. EPA chose to postpone selecting a remedy for addressing the groundwater contamination at Plume 2. The current ROD Amendment is an interim remedy for addressing NAPL at Plume 2.

This ROD Amendment is considered an interim remedy because it addresses sources of TCE and other CVOC to the groundwater contamination. It does not provide a cleanup for the entire 72-acre groundwater contamination plume. A final remedy for Plume 2 will be chosen following the implementation of this interim remedy and the development of adequate data on the success of remedy. The final Plume 2 groundwater remedy will be addressed in a future subsequent ROD Amendment.

VIII. Community Participation

Section 300.435(c)(2)(ii) of the National Oil and Hazardous Substance Pollution Contingency Plan requires public participation in the process of ROD amendment remedy selections. A Proposed Plan to address the groundwater contamination for Plume 2 at Sites 32/33 of the PCB OU was made available to the public on April 17, 2013. Copies of the Proposed Plan and the Administrative Record documents were placed in the information repositories located at the Crab Orchard National Wildlife Refuge Headquarters and at Morris Library, Southern Illinois University in Carbondale, Illinois. The Proposed Plan, fact sheet, and detailed technical documents were made available to the public online at <http://www.epa.gov/region5/cleanup/sangamo>. The notice of public availability of the Proposed Plan and administrative record, and the notice of public meeting were published in the *Southern Illinoisan*, and the *Marion Daily Republican*, the two local newspapers of widest circulation, on April 20, 2013, and April 22, 2013, respectively. A public comment period was held from April 17, 2013 to May 16, 2013. U.S. EPA together with the support agencies, FWS and Illinois EPA, held the public meeting on May 1, 2013, to explain its recommended cleanup plan. At this meeting, representatives from U.S. EPA, IEPA, and FWS answered questions about the remedial alternatives presented in the Proposed Plan.

U.S. EPA received two comments on the Proposed Plan. The responsiveness summary included in this ROD Amendment addresses these comments.

This ROD Amendment to address groundwater contamination for Plume 2 is made part of the Administrative Record file which is maintained at the Crab Orchard National Wildlife Refuge Headquarters, Marion, Illinois.

IX. Site Characteristics

a. Site Setting

The Refuge (Figure 1) is located in southern Illinois, south and west of the City of Marion. It is near the center of the southern tip of the state, approximately 25 miles east of the Mississippi River and approximately 55 miles west the Ohio River. The Refuge includes approximately 43,500 acres of forested land, pine plantations, and cultivated lands. A portion of the Refuge is set aside for industrial purposes. Three lakes are located within the Refuge, including the Crab Orchard Lake, a 7,000-acre man-made reservoir. The western portion of the Refuge around Crab Orchard Lake is open to public use for recreational purposes. The eastern portion of the

Refuge is a wildlife sanctuary that is closed to general public access. Land around the eastern portions of Crab Orchard Lake is also used for industrial purposes.

The construction of Crab Orchard Lake was completed in 1940 as part of the Crab Orchard Project for Land Utilization. A dam that impounds the waters of Crab Orchard Creek and its tributaries created Crab Orchard Lake reservoir. The Dam is located at the extreme western end of the lake and has a spillway elevation of 405 feet above mean sea level (MSL). Crab Orchard Lake is approximately nine miles long and varies in width from approximately 1.5 miles in the west near the dam to approximately 0.5 mile in the eastern end. The average water depth varies over the area of Crab Orchard Lake from approximately two to nine feet with a maximum depth of 30 feet. The majority of the northern boundary of the PCB OU area terminates at a bay on Crab Orchard Lake.

b. Site Geology:

The site geology near Buildings I-1-2 and I-1-3 is composed of unconsolidated sediments and residuum that resides above shallow bedrock. There are four hydrostratigraphic units within the overburden: Upper Clay, Upper Sand, Lower Clay, and Lower Sand. Beneath the unconsolidated overburden lies Pennsylvanian-aged sandstone from the Tradewater Formation.

Upper Clay Unit

The Upper Clay unit is present from the ground surface to between 17 to 26 feet below ground surface (bgs) approximately 400 to 410 feet above MSL with the exception of fill areas near ground surface as a result of excavation activities.

The lean clay is predominantly brown with some sporadic light gray and black soil mottling; is typically firm to stiff; and exhibits low to medium plasticity. The lean clay is relatively featureless and massive. The lean clay also contains varying amounts of silt, gravel and sand that forms thin two- to three-inch seams, and one- to two-foot discontinuous lenses with clayey sand and silty sand. The clay is fractured throughout but has low permeability overall. Slug test data indicates that the hydraulic conductivity of the unit within the source area is on the order of 10^{-5} to 10^{-6} centimeters per second (cm/sec), which is consistent with silt or loess deposits. The general composition, structure, and hydraulic conductivity value of the Upper Clay unit indicates that the unit is likely a weathered loess deposit.

Upper Sand Unit

The Upper Sand (where present) underlies the Upper Clay Unit. The Upper Sand is present at elevations between 396 to 410 feet above MSL and varies in thickness from one-half to two feet thick in the Building I-1-3 area and from zero to 14 feet thick in the Building I-1-2 area. The unit pinches out east of Building I-1-2. The decreasing thickness of the unit east of Building I-1-3 area indicates that the unit may pinch out laterally to the east-northeast.

The Upper Sand unit is predominantly brown to yellowish brown in color. The sand is typically well-graded, fine to coarse grained sand in southern portion of the source area near Building I-1-

2, and very fine to fine grained silty and clayey sand in the northern portion of the source area near Building I-1-3. Slug test data indicates that the hydraulic conductivity of the unit within the source area is on the order of 10^{-4} cm/sec, which is consistent with silty sands, clayey sands, and fine sand deposits. The general composition, structure, and hydraulic conductivity value of the Upper Sand unit indicates that the unit is likely a glacier outwash deposit.

Lower Clay Unit

The Lower Clay unit resides below the Upper Sand unit or the Upper Clay unit (if the Upper Sand is not continuous in this area). The Lower Clay unit is present at elevations between approximately 375 and 406 feet above MSL and varies in thickness from nine to 28 feet thick in Building I-1-3 source area to three to eight feet thick in the Building I-1-2 source area. The thickness of the unit decreases to the south as the top of bedrock elevation increases toward ground surface.

The Lower Clay is typically either brown or yellowish brown at the top of the unit, and either brown or gray at the base of the unit. The lean clay is relatively featureless, massive stiff to hard, and exhibits medium plasticity. The clay contains varying amounts of silt and sand that forms thin two- to three-inch seams, and one- to three-foot thick discontinuous lenses of clayey sand and silty sand. Small angular gravel clasts of the underlying sandstone, limestone, and coal are sporadically spread throughout the unit. Slug tests from outside of the source area indicate that the hydraulic conductivity of the unit is on the order of 10^{-6} cm/sec, which is consistent with clay deposits. The general composition, structure, and hydraulic conductivity value of the Lower Clay unit indicates that the unit is representative of Illinoisan glacial till.

Lower Sand Unit

The Lower Sand is only present in the Building I-1-3 area. The unit is present at elevations within the source areas between approximately 383 to 390 feet above MSL and varies in thickness from four feet on the east side of the building to seven feet immediately west of the building.

The Lower Sand is brown, light gray, and gray in color. The sand is composed of medium to coarse-grained sand and contains trace amounts of clay and silt. Slug tests from outside of the source area indicate that the hydraulic conductivity of the unit is in the order of 10^{-3} to 10^{-4} cm/sec, which is consistent with poorly-graded sand deposits. The general composition, structure, and hydraulic conductivity value of the Lower Sand unit indicates that the unit is likely either a glacial outwash deposit or a reworked deposit derived from the underlying sandstone bedrock.

Bedrock

Bedrock beneath the overburden within the potential source areas is composed primarily of Pennsylvanian-aged sandstones from the Tradewater Formation. Soil borings conducted during investigations first encountered highly weathered sandstone at the overburden/bedrock interface and then competent sandstone immediately below the weathered sandstone. The weathered sandstone is brown to light yellowish brown in color and is composed of fine- and medium-

grained sands that are moderately cemented, highly micaceous, and exhibit thin laminar-bedding planes. The weathered sandstone is extremely friable near the overburden/bedrock interface and increases in strength with depth. Typically within less than one foot of the overburden/bedrock interface, the sandstone transitions from brown to light gray in color, from moderately cemented to well cemented, and from easily friable to hard and competent. The physical characteristics of the sandstone identified in the soil boring logs within the potential source areas are similar to the physical characteristics of the Granger Sandstone Member of the Tradewater Formation.

Bedrock surface occurs at elevations within the potential source areas from approximately 375 feet to 398 feet above MSL. In the southern portion of the source area near Building I-1-1 and Building I-1-2, the top of the bedrock surface ranges from 28 to 38 feet bgs. In the northern portion of the potential source areas near Building I-1-3, the top of the bedrock surface ranges from 38 to 49 feet bgs. Topographically, the top of the bedrock surface within the source area slopes downward to the north, east, and west.

c. Groundwater Flow Characteristics:

The hydrostratigraphy of the site is generally divided into four units: the Upper Clay unit, the Upper Sand unit, the Lower Clay unit, and the Lower Sand Unit. Shallow groundwater (Upper Clay/Upper Sand units) beneath the Site 33 area is affected locally by surface water drainage and by the Area 9 Repository. The general flow directions in the Upper Clay and Upper Sand units are to the north, northwest, and west. However, Buildings I-1-1, I-1-2, and I-1-3 are located upon a groundwater divide and shallow groundwater flows away from a local groundwater high. A majority of the groundwater flow is westerly, influenced by the consistent presence and increased thickness of the Upper Sand in this direction. The horizontal hydraulic gradient is rather slight in the vicinity of Buildings I-1-1, I-1-2, and I-1-3 area ranging from 0.003 to 0.006.

Groundwater in the Lower Sand unit flows to the north toward Crab Orchard Lake. The horizontal hydraulic gradient in the Lower Sand ranges from 0.0004 to 0.0005. Over most of the site, the piezometric head in the Lower Sand is generally one to three feet lower than the head in the Upper Sand, indicating a downward potential. However, near Crab Orchard Lake, this is reversed, indicating an upward potential as groundwater discharges to the lake.

d. Surface Water:

In the southwestern portion of the site, an intermittent stream that appears to originate near Buildings I-1-2/I-1-3 flows westerly toward Highway 148, passes beneath Highway 148 through a culvert pipe, and discharges into the Heron Flats impoundment area on the western side of the highway. The intermittent stream is often dry in its upper reach, except following rainfall events. The lower reach appears to be receiving groundwater inflow and has flowing water over most of the year.

e. Groundwater Contaminant Source for Plume 2:

Based on the soil chemistry data, there are two separate CVOC source areas. One source area is located directly east of Building I-1-2, just south of the former location of the manufacturing

building. The second source is located just east of Building I-1-3, north of the former manufacturing building. The second source area is comprised of two adjacent hot spot areas, both exhibiting high levels of CVOC contamination. The two source areas, although separate, form Plume 2.

Soil contamination

Fourteen volatile organic compounds (VOCs) were detected in soil; 1,1,2-trichloroethane (1,1,2-TCA), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), acetone, chlorobenzene, chloroethane, cis-1,2-dichloroethene (cis-1,2-DCE), ethylbenzene, methylene chloride, PCE, toluene, total xylenes, TCE, and vinyl chloride. The primary VOC detected in most of the samples during the investigations was TCE.

The highest TCE concentration (40 mg/kg) in the Upper Clay unit was found at a depth from 15 to 16 feet bgs on the east side of Building I-1-2. The highest TCE concentration (270 mg/kg) in the Upper Sand unit was found at a depth from 27 to 28 feet bgs on the east side of Building I-1-2. The highest TCE concentration (97 mg/kg) in the Lower Clay/sandstone interface was found at a depth of 33 feet bgs on the east side of Building I-1-2. High concentration of TCE (170 mg/kg) was found in a sand lens within the Lower Clay unit at a depth of 35 to 36 feet bgs on the east side of Building I-1-3. High concentration of TCE (150 mg/kg) was also detected in the Lower Clay unit at a depth of 40 to 42 feet bgs on the east side of Building I-1-3.

Groundwater Contamination

Nine VOCs were detected in groundwater above MCLs in the source area; 1,1,1-trichloroethane, 1,1,2-TCA, 1,1-DCE, cis-1,2-DCE, PCE, toluene, trans-1,2-dichloroethene (trans-1,2-DCE), TCE, and vinyl chloride. The VOC with the highest concentration and most widespread distribution is TCE. The highest TCE concentration of 1,300,000 µg/L in groundwater in Treatment Area 1 (Figure 3) was detected in the Lower Clay/Sandstone interface on the east side of Building I-1-2. High TCE concentrations of 79,000 µg/L at Treatment Area 2 and 270,000 µg/L at Treatment Area 3 (Figure 3) were also detected in groundwater in the Lower Clay unit east of Building I-1-3. The high concentration of 1,300,000 µg/L of TCE is highly suggestive of non-aqueous phase liquid (NAPL) which is a principal threat.

The Conceptual Site Model (CSM) presented in the Groundwater Investigation Report, the Focused Feasibility Report (Revision 1), the analysis provided in the Preliminary Design Report, and the updated CSM presented in the Focused Feasibility Study Report (Revision 4) provides the following understanding of Plume 2:

- Groundwater contaminant sources near Building I-1-2 and I-1-3 are located upon a groundwater divide; the majority of the Plume 2 groundwater flows to the west, though there is a component of flow to the north.
- Contamination has migrated both laterally and vertically within the Upper Clay unit and from the Upper Clay unit to the Upper Sand unit (where it is present).

- Contamination migration is influenced by the higher permeability of the Upper Sand unit, which acts as a preferential pathway.
- Contamination continues to migrate laterally and vertically from the Upper Clay/Upper Sand to the Lower Clay unit. Lateral migration in the Lower Clay likely occurs through sand layers or other permeable features (such as fracture) within the clay matrix.
- Contamination that has migrated through the Lower Clay unit to the Lower Sand unit moves preferentially through the Lower Sand unit in the direction of groundwater flow, which is evident in elevated concentration observed in the Lower Sand on both sides of Building I-1-3.
- The Lower Sand unit was not observed near Building I-1-2, but migration of contamination was observed under the building predominantly in the Upper Sand.
- The presence of TCE daughter products such as 1,1-DCA, cis-1,2-DCE, and vinyl chloride within the upper strata indicates biodegradation is occurring, and data from the investigation suggests the rate of biodegradation is slow.
- The highest concentration of TCE detected in groundwater was in the source area, near Building I-1-2. TCE was detected at a concentration of 1,300,000 µg/L in the Lower Clay unit near the Lower Clay/Sandstone interface. The investigation results indicate that the source area hot spot was identified based on the other locations where borings were advanced to bedrock, and there was no indication that TCE is present at concentrations near the same magnitude. Therefore, the source area hot spot is assumed to be limited to this location and a small area around this location. Two additional source area hot spots located near Building I-1-3, exhibiting lower levels of contamination, also appear to be contributing to Plume 2 groundwater contamination.

X. Current and Future Site and Resource Uses

The 43,500 acre Crab Orchard National Wildlife Refuge is used not only as wildlife refuge, but also for recreational, agricultural, and industrial purposes. The Area 9 Landfill (Site 32) and the Area 9 Building Complex (Site 33) are located in an industrial area. Access is limited to employees working in the Area 9 Building complex and to Refuge personnel. This area is expected to remain as an industrial area in the foreseeable future. The groundwater contamination emanating from Plumes 1 and 3, however, extends beyond the designated industrial area into the Crab Orchard Lake. Crab Orchard Lake is part of the recreational area and an important part of the ecosystem. The groundwater contamination emanating from Plume 2 extends beyond the designated industrial area potentially into a nearby intermittent stream.

U.S. EPA generally defers to State Groundwater Classifications for current or future groundwater uses. Although the groundwater is not used currently for drinking water purposes, the contaminated aquifer at Sites 32/33 has been classified by the State of Illinois as a Class I Potable Resource Groundwater in accordance with Illinois Administrative Code, Title 35, Part 620, Subpart B (Section 620.210). Accordingly, Illinois EPA and U.S. EPA affirm the need to protect the potential future beneficial use of the Sites 32/33 Class I Potable Resource Groundwater by virtue of the interim remedy contained in this ROD Amendment.

XI. Past and Current Site Risks

At the time of the 1990 PCB OU ROD, there were four sites (Sites 17, 28, 32, and 33) contaminated with PCBs, lead, and cadmium. The presence of these contaminants in the soil and sediment at these sites posed an unacceptable risk to human health, environment, and the wildlife at the Crab Orchard National Wildlife Refuge. Remedial action to clean up the above contaminants was completed in 1997. Remedial actions were also conducted in 2004, 2009, and 2012 to remove additional PCB-contaminated soil in the Center Swale drainage area, Tree Stand Area, the 1960s Ditch and other areas within the PCB OU.

The GWI Report identified the presence of TCE and other CVOCs above MCLs in the groundwater in the vicinity of Buildings I-1-23 and I-1-2/I-1-3 that posed a risk to potential drinking water users. The 2007 ROD Amendment addressed groundwater contamination for Plumes 1 and 3 near Building I-1-23. Schlumberger, as the Settling Defendant, completed the remedial activities in 2011 to address Plumes 1 and 3 groundwater contamination. This ROD Amendment addresses remediation of Plume 2 contaminated groundwater.

XII. Remedial Action Objectives

40 CFR 300.430(a)(1)(iii)(F) of the National Contingency Plan (NCP) states:

"EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site. When restoration of ground water to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction."

The State of Illinois has determined that the contaminated aquifer is a Class I Potable Groundwater Resource. Although the groundwater at this location is currently not used for drinking water purposes, the potential future groundwater use is for drinking water purposes.

Therefore, a final remedial goal for Sites 32/33 is to restore contaminated groundwater at Sites 32/33 to Drinking Water Standards/Illinois Class I standards to the maximum extent practicable.

The Remedial Action Objectives for this interim remedy are as follows:

- Effectively treat locations of non-aqueous phase liquid (NAPL) at Plume 2;
- Reduce or control, to the maximum extent practicable, the impact of subsurface sources of volatile organic compounds on the groundwater quality.

XIII. Description of Remedial Alternatives

All alternatives, with the exception of the No Action alternative, include Long-Term Management and Institutional Controls. The following includes a brief description of various

components of the remedial alternatives included in the Proposed Plan. Detailed description of these components can be found in the FFS Report (Revision 4) for the PCB OU.

No Action: This alternative consists of taking no action. The NCP requires that a no action alternative be retained throughout the feasibility study process as a baseline against which to compare the other alternatives. The “No Action” alternative is considered ineffective at achieving the remedial action objectives.

Excavation: This component consists of excavation and off-site disposal of soil within the source area at Treatment Areas 1, 2, and 3 from ground surface to bedrock.

Soil Mixing with Zero Valent Iron (ZVI): This component consists of an in-situ technology that uses a large auger system, equipped with nozzles, to add a clay-granular ZVI slurry into the soil in both the vadose and saturated zones while mechanically breaking up and mixing the soil. Shallow soil mixing, via the auger system, converts the source zone into a homogenous mixture of soil, clay, iron, and target contaminants by turning the auger while repeatedly cycling up and down throughout the mixing column. The ZVI degrades the CVOCs in both the vadose and saturated zones through chemical reduction and also promotes subsequent biological degradation. In addition to treatment of CVOCs associated with soil matrix, introduction of the mixture into the saturated zone will also result in the treatment of CVOCs in the groundwater within the source areas. Also, the addition of clay and mixing of the soil column reduces the potential of contaminants to flow away from the source zone through a reduction in hydraulic conductivity.

The Soil Mixing component of the remedy consists of mixing soil with a mixture of clay and ZVI to treat the soil and groundwater within the target treatment zones located at Treatment Areas 1, 2, and 3 (Figure 3). A mix design of 2.5 percent ZVI and 1 percent bentonite is assumed for the target treatment zones. Short term groundwater monitoring will be needed to evaluate the effectiveness of the soil mixing and ZVI treatment, and will provide data to determine the necessary final site groundwater remedial action.

Thermal Conductive Heating: Also known as in situ thermal desorption, this technology generates heat using electrical power, based on resistive principles. The heat generated through the process mobilizes the CVOCs which are then collected and appropriately managed. Thermal conductive heating systems consist of heater assemblies installed in the ground within sealed steel well casings, electrical power distribution equipment, vapor and groundwater extraction wells which capture mobilized CVOCs, and an above-ground plant to treat extracted process vapor and fluids. Multiple heater assemblies are placed across the treatment zone at relatively close spacing to ensure thorough conductive heating. Recovery wells are placed to capture groundwater and vapor mobilized during heating.

The Thermal Conductive Heating component of the remedy consists of implementing the heating system within the source area at Treatment Areas 1, 2, and 3.

Long-Term Management (LTM): This component includes groundwater monitoring to detect changes in groundwater contaminants of concern (COC) concentrations and manage any

associated risks. A select number of existing and newly installed monitoring wells will be sampled as part of the LTM program. Proposed monitoring wells will be screened within the Upper Clay, Upper Sand, Lower Clay, and Lower Sand units. The existing and newly installed wells will monitor the CVOC source area and along the plume centerline.

Institutional Controls (ICs): This component prohibits the installation of potable water wells until the groundwater is restored to the drinking water standards (Figure 2). The FWS has placed certain ICs at the Illinois Ordnance Plant Industrial Areas (administered by FWS) and other areas currently being investigated, including controls for Sites 32 and 33 of the PCB OU. These controls are documented in the April 2008 Environmental Land Use Control (ELUC) Plan prepared and enforced by the FWS. The plan prohibits the installation of production wells within the boundary of the former Illinois Ordnance Plant. However, recorded, enforceable ICs that prohibit the installation of potable wells until the groundwater is restored to drinking water standards will have to be part of any remedy chosen in order for the existing ICs to be sufficiently effective.

The following are the remedial alternatives intended to address Plume 2 groundwater contamination near Buildings I-1-2 and I-1-3:

- Alternative 1 No Action
- Alternative 2 Excavation, Long-Term Management, and Institutional Controls
- Alternative 3 Soil Mixing with Zero Valent Iron, Short -Term Monitoring, and Institutional Controls
- Alternative 4 Thermal Conductive Heating, Long-Term Management, and Institutional Controls
- Alternative 5 Long-Term Management and Institutional Controls

XIV. Applicable or Relevant and Appropriate Requirements (ARARs)

The following federal and state ARARs apply to one or more of the remedial alternatives for the groundwater at Sites 32/33:

1. Chemical-specific ARARs
 - 40 CFR 141 - MCLs promulgated under the Safe Drinking Water Act.
 - 35 IAC Part 620 – Groundwater Quality, Subpart D, Section 620.410, Class I Groundwater Quality Standards.
 - 35 IAC Part 302, Subpart B – General Use Water Quality Standards, specifically Part 302.208 – Numeric Standards for Chemical Constituents, and Part 302.1210 – Other Toxic Substances. Achieve Source area hot spot in situ soil treatment to achieve compliance with groundwater standards.
2. Action Specific ARARs
 - 40 CFR 122.41 and 122.44 – Clean Water Act: If any ditch water from Sites 32/33 must be discharged to a surface water body during site

preparation, the discharge shall meet the effluent standards and prohibitions and water quality standards established under Sections 301, 302, 303, 307, 318, and 405 of the Clean Water Act.

- 35 IAC Part 304, Subpart A – General Effluent Standards, specifically Parts 304.102 and 304.105 to 141 – For discharges to waters of the state.
- 35 IAC Part 305 – Monitoring and Reporting, specifically Parts 305.102 to 103 – For discharges to waters of the state.
- 35 IAC Part 306, Subpart A – Systems Reliability, specifically Part 306.102
- 35 IAC Part 309, Subpart A – NPDES Permits – Substantive requirements pertinent to construction and operation of contaminated groundwater treatment or pretreatment works and to point source discharges to waters of the state.
- 35 IAC Part 620 – Groundwater Quality, Subpart D, Section 620.405, General Prohibition against Violations of the Groundwater Quality Standards: No person shall cause, threaten or allow the release of any contaminant to groundwater so as to cause a groundwater quality standard to be exceeded.
- 40 CFR 262.34; and 264, Subparts B, C, I, J, and L - Resource Conservation and Recovery Act (RCRA), Subtitle C – Excavated material which is RCRA hazardous will be handled and stored in accordance with the substantive technical standards applicable to generators of hazardous waste and for owners and operators of hazardous waste and for owners and operators of hazardous waste storage facilities.
- 40 CFR 268 – Excavated material which is RCRA hazardous will be handled and stored in accordance with the land disposal restrictions
- 40 CFR 264, Subpart G – The excavation activities, when completed, shall meet the closure performance standards for clean closure.
- 40 CFR 50.6 and 50.12 - Clean Air Act – During excavation the National Ambient Air Quality Standards (NAAQS) for particulate matter and lead shall not be exceeded.
- 35 IAC Part 212-Visible and Particulate Matter Emissions.
- 35 IAC 245-Odor Control.
- 35 IAC Parts 900, 901 and 910: Controls to comply with nuisance noise levels. .
- 35 IAC Subtitle B – Air Pollution, Part 201 – Substantive permitting requirements under Parts 201.141, .143, .152-.165, .207-.210, .261-.265, .282-.283, .310-.312 for construction or modification of an emission source.
- 35 IAC 704 – UIC Permit Program; 35 IAC Part 730 – Underground Injection Control Operating requirements: Achieve requirements implemented during the injection of ZVI during soil mixing.
- 35 IAC Part 722 – Standards Applicable to Generators of Hazardous Waste – If solid waste (defined per 35 IAC Part 721.102) is generated, the generator must determine if that waste is hazardous.

- 35 IAC Subtitle G – Waste Disposal, specifically Parts 724 and 728 – If hazardous waste is present on a site, pertinent requirements of hazardous waste treatment, storage, and disposal under 35 IAC Subtitle G (Waste Disposal) must be followed.
- 35 IAC Parts 720 to 723, 725 to 727, and 729-Hazardous Waste Management Requirements.
- 35 IAC Part 808 – Special Waste Classifications – Generators of a waste must classify the waste. A special waste (defined per Section 3.45 of Illinois Environmental Protection Act) determination is required under 35 IAC Part 808.12. Management of special waste must be in accordance with 35 IAC Subtitle G (Waste Disposal), including 35 IAC Part 809 (Special Waste Hauling) and 35 IAC Part 810 (Solid Waste Disposal).
- 40 CFR 264.114 – RCRA, Subtitle C – During remediation and closure all equipment, structure, and soils that are used on /with RCRA hazardous material must be properly decontaminated or disposed of.
- 35 IAC Part 724 – Decontamination of equipment, structures, and soils that are used on/with RCRA hazardous materials must meet any more stringent regulatory decontamination or disposal standards of the State of Illinois.
- 40 CFR 50.6 – During backfilling activities the NAAQS for particulate matter shall not be exceeded.
- 40 CFR 264, Subpart F – RCRA Subtitle C – Groundwater monitoring for the remediated sites shall be in accordance with the groundwater monitoring requirements of RCRA.
- 35 IAC Part 807-Groundwater and Leachate monitoring.
- 40 CFR 761.65-Storage Requirements, Toxic Substances Control Act (TSCA) – Excavated material characterized, managed and stored.
- 40 CFR 761.79 – Decontamination Standards and Procedures; TSCA
- 49 CFR 100-109-Hazardous Materials Transportation Act.
- 29 CFR 1910.120 and 1926, Subparts C, D, E, and P – Occupational Safety and Health Act (OSHA) – During all remedial activities the requirements of OSHA for the training and safety of workers will be observed.

3. Location Specific ARARs

- National Wildlife Refuge Administration Act (16 USC 668dd).
- Fish and Wildlife Coordination Act (16 USC 661-666).
- Migratory Bird Treaty Act of 1918 (16 USC 703-711, as amended).
- Endangered Species Act – 16 USCA Sections 1531 to 1544.
- Archeological and Historic Preservation Act – 16 USCA Sect. 469.
- Native American Graves Protection and Repatriation Act – (25 USC 3001).

4. To Be Considered

- USEPA Regional Screening level Table for Chemical Contaminants at Superfund Sites.
- 35 IAC Part 742 (Illinois Tiered Approach to Corrective Action Objectives).

XV. Evaluation of Alternatives

a. Evaluation Criteria

U.S. EPA's evaluation of remedial alternatives is based on the nine criteria set forth in the National Contingency Plan (NCP), 40 CFR Part 300. These criteria are described below.

A remedial alternative is judged first in terms of the threshold criteria of: (1) protecting human health and the environment, and (2) complying with Applicable or Relevant and Appropriate Requirements (ARARs) of federal or more stringent state, environmental or facility citing laws. If a proposed remedy meets these two criteria, it is then evaluated against the balancing and modifying criteria in order to arrive at a final recommended alternative.

Threshold Criteria

1. Overall protection of human health and the environment: U.S. EPA determines whether an alternative adequately protects human health and the environment from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site.
2. Compliance with ARARs: U.S. EPA evaluates whether an alternative attains applicable or relevant and appropriate requirements under federal or more stringent state environmental or facility citing laws, or provides grounds for invoking a waiver.

Balancing Criteria

3. Long-term effectiveness and permanence: U.S. EPA considers the ability of an alternative to maintain protection of human health and the environment over time, and the reliability of such protection.
4. Reduction of contaminant toxicity, mobility, or volume through treatment: U.S. EPA evaluates the degree to which an alternative uses treatment to address the principal threats posed by the site.
5. Short-term effectiveness: U.S. EPA considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
6. Implementability: U.S. EPA considers the technical and administrative feasibility of implementing the alternative, such as relative availability of goods and services.

7. Cost: U.S. EPA estimates an alternative's capital and O&M costs and calculates the present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollars.

Modifying Criteria

8. State acceptance: U.S. EPA considers any concerns the state has raised with respect to the preferred alternative, other alternatives, or with ARARs or ARAR waivers.

9. Community Acceptance: U.S. EPA considers which components of the alternatives interested persons in the community support, have reservations about, or oppose.

b. Application of the Evaluation Criteria to the Cleanup Alternatives

As part of the evaluation process, each alternative is evaluated against the nine criteria outlined above. The ROD Amendment briefly summarizes the outcome of this evaluation with the goal of identifying the alternative that best meets the nine criteria.

Groundwater Plume near Buildings I-1-2/I-1-3 (Plume 2)

1. Overall Protection of Human Health and the Environment:

All of the alternatives, with the exception of Alternative 1, would provide interim action that would be protective of human health and the environment in the short-term and would provide adequate protection until a final ROD is signed. Alternative 5 provides overall protection of human health and the environment through LTM of the dissolved TCE groundwater plume and ICs to prohibit the use of groundwater until cleanup objectives are achieved. In addition to the LTM and ICs, Alternative 2 includes the excavation and off-site disposal of the contaminated soil in three hot spot areas, whereas, Alternatives 3 and 4 include in situ treatment of the hot spot areas to remove contaminants in soil and groundwater.

2. Compliance with ARARs:

All of the alternatives with the exception of the Alternative 1 will comply with the ARARs identified in the FFS Report.

3. Long-Term Effectiveness and Permanence:

Alternatives 1 and 5 are anticipated to take greater than 500 years to provide long-term effectiveness and permanence because high TCE concentrations detected at the soil and bedrock interface within the source area hot spots will continue to diffuse into the groundwater. Alternatives 2, 3, and 4 provide long-term effectiveness and permanence through a source area hot spot removal or treatment. Since this is an interim groundwater remedy, how and when the final groundwater remedial action objectives will be met will depend on the final groundwater

remediation measures. Those final measures will be determined after the interim remedy is implemented and evaluated.

For the purpose of comparing the effectiveness of the interim remedial alternatives, the proposed interim remedies are assumed to be the final groundwater action at the site. With that assumption, the overall estimated remediation time frames for the remedial alternatives range from 75 to 280 years. The projected cleanup time assumes natural attenuation of the remaining groundwater contamination after the interim groundwater measure is implemented. The range in the length of cleanup time reflects the uncertainty of the actual rate of natural degradation of TCE. The shorter time frame is based upon a shorter TCE half-life (5 years) and the longer time frame is based upon a longer TCE half-life (20 years). The following are the time frames for all alternatives:

- Alternative 1 --- greater than 500 years
- Alternative 2 --- 75 to 280 years
- Alternative 3 --- 75 to 280 years
- Alternative 4 --- 75 to 280 years
- Alternative 5 --- greater than 500 years

4. Reduction of toxicity, mobility, and volume through treatment:

Both Alternatives 3 and 4 are effective in reducing the toxicity, mobility, and volume of contaminants in the groundwater through treatment. Alternatives 1, 2, and 5 do not use treatment as a component of the remedy.

5. Short-Term Effectiveness:

Alternative 2, which includes excavation and off-site disposal of the contaminated soil, has the highest level of potential exposure of on-site workers and the community to hazards during implementation than other alternatives. This is due to the large volume of traffic transporting hazardous and non-hazardous waste from the excavated area to disposal facilities. Proper precautions would be taken during excavation and off-site disposal of the contaminated soil to minimize any risk to the public and the workers from potential health risks. ICs provide short-term effectiveness by prohibiting the installation of potable water wells until the groundwater is restored to beneficial use.

Alternative 3 has the lowest short-term risk because of the relatively short duration of on-site work and the relatively small amount of materials manufactured and transported to the site.

6. Implementability:

Alternatives 1 and 5 are easily implementable technically. All of the alternatives are easily implemented administratively.

Alternative 2 is technically feasible for removal of the source area soil. However, the depth of this excavation and presence of site encumbrances makes this alternative more difficult to

implement than the other alternatives. The proximity of Building I-1-2 to the excavation requires soldier piles to be drilled into bedrock and shoring to support the excavation sidewall parallel to the building. The excavation depth will require the remaining sidewalls to be benched and sloped in a manner that results in the over-excavation and disposal of a volume of soil outside the target treatment zone limits. The target excavation depth extends well below the water table, presenting excavation stability hazards and technical challenges that could limit the feasibility to effectively complete the excavation to the target limits. Excavation activities associated with Alternative 2 will require more time to implement than soil mixing operations associated with Alternative 3 due to the logistics associated with excavating, handling, and transporting a large volume of soil.

Alternative 3 is technically feasible and not as logistically challenging as Alternatives 2 and 4 to implement. Soil mixing operations associated with Alternative 3 will require less time (one to two months) to implement than excavation activities associated with Alternative 2 and construction, operation, and maintenance activities associated with Alternative 4. The soil within the mixing area could remain structurally unstable for months to years following completion of soil mixing activities. The soil mixing area will need to be fenced off to prevent unauthorized access to or constructing on top of the soil mixing area before the soil has had time to stabilize.

Alternative 4 is technically feasible to implement at this site. A longer time will be required to finish implementing Alternative 4 within the target treatment zone than will be required for Alternatives 2 and 3 because of the operation time associated with the treatment system. Following design and construction, the total estimated operation time is 100 days. Alternative 4 will require installation of an electric service line. The cost and time required to install temporary electric service is dependent on the ability of the existing power grid to support the system's power requirements. Unlike Alternatives 2 and 3, follow-on maintenance of the remediation system will be required. Following active treatment and shutting down of the system, the subsurface will need a cooling period before the system can be decommissioned. After adequate time has passed, the process equipment will be demobilized and the associated infrastructure will need to be abandoned.

7. Cost:

The estimated capital, annual O&M, and present worth cost for each of the alternatives has been calculated for comparative purposes and is presented in the following table.

Summary of Estimated Costs for Each Alternative		
Alternatives	Total Capital Cost	Total Present Worth Cost
Alternative 1 No Action	---	---
Alternative 2 Excavation, Long-Term Management, and Institutional Controls	\$9,708,258	\$9,955,000
Alternative 3 Soil Mixing, Short-Term Monitoring, and Institutional Controls	\$1,026,010	\$1,273,000
Alternative 4 Thermal Conductive Heating, Long-Term Management, and Institutional Controls	\$3,710,716	\$3,957,000
Alternative 5 Long-Term Management and Institutional Controls	\$97,323	\$344,000

Of the active remedial alternatives, Alternative 5 has the lowest total present worth cost and Alternative 2 has the highest. This is because Alternative 5 includes LTM and ICs only, while Alternative 2 includes excavation and off-site disposal of contaminated soil in addition to the LTM and ICs.

8. State Acceptance:

The Illinois EPA has indicated their support for selection of Alternative 3 as the revised interim remedy. The letter documenting their support has been added to the Administrative Record.

9. Community Acceptance:

U.S. EPA received two written/electronic mail comments during the public comment period, both from FWS. The responsiveness summary included in this ROD Amendment addresses these comments.

XVI. The Selected Interim Remedy

Groundwater Plume near Buildings I-1-2/I-1-3 (Plume 2)

The Preferred Alternative for the Building I-1-2/I-1-3 Source Area and Plume 2 is Alternative 3 from the FFS and the Proposed Plan, as an interim remedy. It consists of soil mixing with Zero-Valent Iron, and Short-Term Monitoring to evaluate the effectiveness of the interim groundwater

cleanup measure and any further appropriate cost effective final remedial actions, and institutional controls.

This preferred interim groundwater alternative consists of mixing soil with a mixture of clay and ZVI to treat soil and groundwater within the target treatment zones located at Treatment Areas 1, 2, and 3 from three feet below grade until hard and competent bedrock is reached. In addition to treating the soil, introduction of the ZVI mixture into the saturated zone will also treat groundwater in the source areas. Before the soil mixing commences, the top three feet of soil within the proposed mixing area will be excavated, and re-used as appropriate, to form a temporary bermed impoundment for material handling and mixing operations.

Soil mixing, however, has the potential to bring deeper soils to the surface. Because the deeper soil may be contaminated with PCBs, subsurface soils brought to the surface will be tested for compliance with the PCB OU cleanup standards. Only soil that meets the cleanup criteria for the upper one foot, established by the 1990 PCB OU ROD, will be used for berms, regraded at the surface, or otherwise used in the upper one foot. Soil brought from depth that does not meet the cleanup criteria will be appropriately disposed off-site.

During implementation, the soil mix rig will be tracked into position over a predesigned and surveyed grid network. To ensure uniform mixing and treatment within the soil mixing area, soil mixing columns will overlap between 25 and 35 percent. The center to center assumed distance between the columns will be spaced to account for overlap of adjacent columns. It is estimated that a 10-foot diameter auger will be advanced to bedrock within the treatment zone at the Treatment Areas 1, 2k, and 3. A mix design of 2.5 percent ZVI and 1 percent bentonite is assumed for the target treatment zone. A bench scale study may be necessary to optimize the amount of ZVI and clay to be added during mixing. Water that collects within the bermed area will be pumped to storage tanks and subsequently treated. A detailed evaluation of the water treatment remedy will be required as part of the remedial design. A detailed site-specific plan for implementability of the soil mixing remedy will be required as part of the remedial design. The remedial design may also include a provision for a pilot study, if necessary, to demonstrate the effectiveness of the mixing process.

Following completion of the mixing activities, the bermed soil will be regraded across the soil mixing area. Because of the time required for the mixing soil to stabilize, a chain link fence will be installed around the mixing area to prevent unauthorized persons and vehicles from passing across the structurally unstable soil, until the soil is considered structurally stable.

To determine the treatment zone targets, bounding samples will be collected during remedial design. Borings for bounding samples will extend to hard and competent bedrock. The target treatment zones will be adequately bounded when sampling demonstrates that less than 50 mg/kg TCE is present in soil and less than 200 mg/L TCE is present in groundwater.

The Short-Term Monitoring (STM) component of the interim remedy includes groundwater monitoring to detect changes in concentrations of contaminants in groundwater. The STM will ensure that the NAPL at Treatment Area 1, and hot spot areas at Treatment Areas 2 and 3 at Plume 2 have been effectively treated. Monitoring wells will be screened within the Upper Clay,

Upper Sand, Lower Clay, and Lower Sand units. The existing and newly installed wells will monitor the CVOC source area and along the plume centerline. The STM will evaluate the effectiveness of the interim groundwater cleanup measure and also serve as input to help identify any further appropriate final remedial actions. The STM will continue until results are sufficient to reasonably project future groundwater concentrations or until the next five-year review following the interim remedy-in-place, whichever is shorter. If modeling, based on the STM results, indicates that the groundwater RAOs will be achieved for the entire plume within 75 to 145 years (which is considered a reasonable time frame for a site with no anticipated near-term groundwater use), then an LTM program may be developed as part of a final remedy for Plume 2. If the modeling does not indicate that the interim remedy is effective, other alternatives may be considered and evaluated. These alternatives may include expanding the zone of ZVI soil mixing and any other alternatives appropriate for conditions at the site.

The ICs component of the interim remedy will prohibit the installation of production wells until groundwater is restored to drinking water standards. U.S. EPA, Illinois EPA, and FWS anticipate entering into a Land Use Control Memorandum of Agreement consistent with the Illinois Uniform Environmental Covenant Act to ensure the durability of ICs for Plume 2.

This interim remedy was selected over other alternatives because it complies with ARARs, has better effectiveness than other alternatives, satisfies preference for treatment, has lower present worth cost of \$1,273,000 when compared with other active interim Alternatives 2 and 4, and will provide adequate protection of human health and environment in the short term until a final ROD is signed.

XVII. Statutory Determinations

Under CERCLA §121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the revised interim remedy meets these statutory requirements.

A. Protection of Human Health and the Environment

The interim remedy for Plume 2 includes soil mixing with ZVI, STM, and ICs to prohibit the installation of any production water wells until groundwater is restored to drinking water standards. The soil mixing component of the Plume 2 interim remedy consists of mixing the soil with a mixture of clay and ZVI to treat the soil and groundwater within the treatment zones located at Treatment Areas 1, 2, and 3 (Figure 3). The ZVI degrades the CVOCs in soil and groundwater through chemical reduction and also promotes subsequent biological degradation. The STM component of the interim remedy includes groundwater monitoring to evaluate the effectiveness of the interim groundwater cleanup measure, and to serve as input to identify and evaluate any further appropriate, cost effective final remedial actions. Potential future remedial

actions include, but are not limited to, additional active measures, monitored natural attenuation, and no further action. The treatment of CVOCs through the soil mixing technology, together with STM and ICs to prohibit the installation of production water wells until groundwater is restored to drinking water standards, will provide adequate protection of human health and the environment in the short-term until a final ROD is selected. There are no short-term threats associated with the revised remedy for Plume 2 that cannot be readily controlled.

B. Compliance with ARARs

The selected interim remedy for groundwater remediation meets the ARARs presented in the following sections. This ROD Amendment will not affect other ARARs selected in the 1990 PCB OU ROD or the ARARs selected in the 2007 PCB OU ROD Amendment.

1. Chemical Specific ARARs

40 CFR 141 – MCLs promulgated under the Safe Drinking Water Act: The groundwater at these sites are not currently being used as a source of drinking water, but the aquifer at these sites could potentially be used as a drinking water source in the future.

Illinois Groundwater Quality Standards: 35 IAC Part 620, Subpart D, Section 620.410 Illinois Class I Groundwater Standards – Since the Illinois Class I Groundwater Quality Standards for the contaminants of concern are the same as MCLs, Illinois groundwater standards would be met within the treated areas.

General Use Water Quality Standards: 35 IAC Part 302, Subpart B – specifically Part 302.208 - Numeric Standards for Chemical Constituents, and Part 302.210 – Other Toxic Substances: Source area in situ soil treatment will reduce the long-term chance of surface water violations where Plume 2 groundwater discharges into surface water.

2. Action Specific ARARs:

Illinois Groundwater Quality Standards: 35 IAC Part 620, Subpart D, Section 620.405, General Prohibitions Against Violations of the Groundwater Quality Standards – Exceedances of Illinois Class I Groundwater Quality Standards are impetus for corrective action. Undertaking the recommended remedial alternative in this ROD amendment will correct these violations within the treated areas.

40 CFR 122.41 and 122.44 - Clean Water Act: If ditch water from Sites 32/33 must be discharged to surface water body during site preparation, the discharge shall meet the effluent standards and prohibitions and water quality standards established under Sections 301, 302, 303, 307, 318, and 405 of the Clean Water Act.

40 CFR 50.6 and 50.12 – Clean Air Act: During excavation and backfilling activities the National Ambient Air Quality Standards (NAAQS) for particulate matter shall not be exceeded.

40 CFR 262.34 and 264, Subparts B, C, I, J, and L – RCRA Subtitle C: Excavated material which is RCRA hazardous will be handled and stored in accordance with the substantive technical standards applicable to generators of hazardous waste and for owners and operators of hazardous waste storage facilities.

40 CFR 264, Subpart G: The excavation activities, when completed, shall meet the closure performance standards for clean closure.

40 CFR 264.114 RCRA Subtitle C: During remediation and closure all equipment, structures, and soils that are used on/with RCRA hazardous materials must be properly decontaminated or disposed of. Decontamination of equipment, structures, and soils that are used on/with RCRA hazardous materials must meet any more stringent regulatory decontamination or disposal standards of the State of Illinois (35 IAC Part 724).

40 CFR 264 Subpart F: Groundwater monitoring for the remediated sites shall be in accordance with the groundwater monitoring requirements of 40 CFR 264 Subpart F.

40 CFR 268: Excavated material which is RCRA hazardous waste will be handled and stored in accordance with the land disposal restrictions. The excavation and storage activities must also meet any more stringent State of Illinois equivalent provisions (35 IAC Part 724 requirements)

40 CFR 761.61, 761.62, and 761.75 Toxic Substances Control Act: Handling and disposal of PCB remediation wastes shall be in accordance with the 761.61, 761.72, and 761.75 and meet any more stringent regulatory disposal requirements of the State of Illinois.

40 CFR 761.65 Toxic Substances Control Act: Excavated material which contains PCBs at concentrations of 50 parts per million will be handled and stored in accordance with the requirements of 40 CFR 761.65.

40 CFR 761.79: Decontamination Standards and Procedures, TSCA.

35 IAC Subtitle B Part 201: Air Pollution – Substantive permitting requirements under Parts 201.141, .143, .152-.165, .207-.210, .261-.265, .282-.283, .310-.312 for construction or modification of an emission source.

35 IAC Part 304, Subpart A, Parts 304.102 and 304.105 to 304.141: General Effluent Standards for discharges to waters of the state.

35 IAC Part 807: Groundwater and Leachate monitoring.

35 IAC Parts 305.102 to 305.103: Monitoring and Reporting for discharges to waters of the state.

35 IAC Part 306, Subpart A: Systems Reliability – Part 306.102: Achieve water treatment works and associated facilities designed to meet operational standards.

35 IAC Part 309, Subpart A: NPDES Permits – Substantive requirements pertinent to construction and operation of contaminated groundwater treatment or pretreatment works and to point source discharges to waters of the state.

35 IAC 704 – UIC Permit Program; 35 IAC Part 730 – Underground Injection Control Operating Requirements: Achieve requirements implemented during the injection of zero valent iron (ZVI) during soil mixing.

35 IAC Parts 720 to 723, 725 to 727, and 729: Hazardous Waste Management Requirements.

35 IAC Part 722: Standards Applicable to Generators of Hazardous Waste – If solid waste (defined per 35 IAC Part 721.102) is generated, the generator must determine if that waste is a hazardous waste.

35 IAC Subtitle G, Parts 724 and 728: Waste Disposal – If hazardous waste is present on a site, pertinent requirements of hazardous waste treatment, storage, and disposal under 35 IAC Subtitle G (Waste Disposal) must be followed.

35 IAC Part 808: Special Waste Classifications – Generators of a waste must classify the waste. A special waste (defined per Section 3.45 of Illinois Environmental Protection Act) determination is required under 35 IAC Part 808.12. Management of special waste must be in accordance with 35 IAC Subtitle G (Waste Disposal), including 35 IAC Part 809 (Special Waste Hauling) and 35 IAC Part 810 (Solid Waste Disposal).

35 IAC Part 212: Visible and Particulate Matter Emissions.

35 IAC 245: Odor Control to be implemented if applicable.

35 IAC Parts 900, 901, 910: Controls to comply with nuisance noise levels.

29 CFR 1910.120 and 1926, Subparts C, D, E, and P: Occupational Safety and Health Act (OSHA) – During all remedial activities the requirements of OSHA for the training and safety of workers will be observed.

3. Location Specific ARARs

National Wildlife Refuge Administration Act (16 USC. 668dd): This law is applicable to areas designated as part of the National Wildlife Refuge System. It requires that remedial action that takes place at Sites 32/33 be compatible with the established purposes of the Refuge.

Endangered Species Act – 16 USC Sections 1531 to 1544: This law is applicable, if endangered species or critical habitat is present at Sites 32/33.

Archeological and Historic Preservation Act – 16 USC Sect. 469: This law is applicable to any archeological or historical artifact uncovered during remedial activities.

Native American Graves Protection and Repatriation Act – (25USC 3001): This law is applicable, if Native American relics or cultural items are found during remedial activities.

Migratory Bird Treaty Act of 1918 (16 USC 703-711): Achieve Migratory Bird Survey conducted prior to implementing action.

Fish and Wildlife Coordination Act (16 USC 661-666): This law is applicable if the remedial action includes water related projects that may affect fish and wildlife and requires action to prevent loss or damage to these resources.

3. To Be Considered

USEPA Regional Screening level Table for Chemical Contaminants at Superfund Sites.

35 IAC Part 742: Illinois Tiered Approach to Corrective Action Objectives.

C. Cost Effectiveness

In U.S. EPA's judgment, the revised interim remedy is cost-effective and meets all other requirements of CERCLA. Section 300.430(f)(1)(ii)(D) of the NCP requires U.S. EPA to evaluate the cost-effectiveness by comparing all of the alternatives which meet the threshold criteria (overall protection of human health and the environment and compliance with ARARs), against three additional balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness is then compared to cost to determine whether a remedy is cost effective. The revised interim remedy was chosen over other alternatives, because it provides adequate overall protection of human health and the environment; complies with ARARs; has better effectiveness than other alternatives; satisfies the preference for treatment; and has lower present worth cost of \$1,273,000 when compared with other active remedial alternatives 2 and 4. Following construction and monitoring, U.S. EPA will evaluate the effectiveness of the interim remedial action and determine whether any further appropriate, cost-effective final remedial measures are necessary.

D. Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the maximum extent practicable.

This interim action utilizes treatment and supports the statutory mandate for permanent solutions and treatment technologies to the maximum extent practicable. U.S. EPA has determined that the revised interim remedy provides the best balance of trade-offs in terms of the nine criteria, while also considering the statutory preference for treatment as a principal element, the bias against off-site disposal without treatment, and State and community acceptance.

E. Preference for Treatment as a Principal Element

The soil mixing component of the revised remedy for Plume 2 consists of mixing soil with a mixture of clay and ZVI to treat soil and groundwater within the treatment zones. The ZVI

degrades the CVOCs in soil and groundwater through chemical reduction and also promotes subsequent biological degradation. By utilizing treatment, the statutory preference for remedies that employ treatment as a principal element is satisfied.

F. Five-Year Review Requirements

Because the remedy selected under this ROD Amendment and the 1990 PCB OU ROD will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years of initiation of construction of the remedial action. The statutory review will be conducted to ensure that the remedy is, or will be, protective of human health and the environment. Because this is an interim remedy, review of the Plume 2 remedy will be ongoing as EPA continues to evaluate the effectiveness and develop final remedial alternatives for Plume 2.

XVIII. Documentation of Changes from Proposed Plan

The Proposed Plan to amend the 1990 PCB OU ROD for Plume 2 was released for public comment in April 2013. U.S. EPA reviewed all comments submitted during the public comment period. In response to the comments by FWS, U.S. EPA has determined at this time, only an interim remedy, not a final remedy, was appropriate for Plume 2. The "Long Term Management" component of the remedy as described in the Proposed Plan has been replaced by "Short Term Monitoring" until a final remedy is selected.

APPENDIX A

Responsiveness Summary

Amendment 2 to the Record of Decision for the PCB Areas Operable Unit Crab Orchard National Wildlife Refuge Superfund Site, Marion, Illinois

This responsiveness Summary summarizes the public comments the United States Environmental Protection Agency (U.S. EPA) received on the Proposed Plan for the second Amendment to the August 1990 PCB Areas Operable Unit Record of Decision (1990 PCB OU ROD) and the June 23, 2000 Explanation of Significant Differences (ESD), and U.S. EPA's responses to those comments. The Proposed Plan was released to the public on April 17, 2013, and the public comment period was held from April 17 through May 16, 2013.

The U.S. EPA received two written comments from the U.S. Fish and Wildlife Service (FWS). Copies of the comments received are included in the Administrative Record for the Site. U.S. EPA carefully considered these comments prior to selecting the remedy documented in the ROD Amendment 2 for the PCB OU.

U.S. EPA initially had chosen Alternative 3 as its preferred remedy. The major components of Alternative 3 were Soil mixing with Zero Valent Iron, Long-Term Management, and Institutional Controls. After reviewing and considering FWS comments, U.S. EPA modified the long-term management component of the remedy to short-term monitoring. The remedy selected is now an interim remedy. After the interim remedial action is implemented and the results of the short-term monitoring are evaluated, a final groundwater remedy for the PCB OU will be selected.

FWS's letter dated May 16, 2013, requested U.S. EPA to:

1. Revise the preferred alternative to ensure that it is protective of human health based on a construction worker exposure scenario (or provide data to demonstrate that the preferred alternative is protective under this scenario);
2. Revise the preferred alternative to require a larger area of treatment in order to reduce and make more realistic the estimated cleanup time estimates; and
3. Revise the preferred alternative to reduce the scope and duration of long-term monitoring.

FWS's letter dated May 17, 2013 (comments from the Refuge Manager, Crab Orchard National Wildlife Refuge) requested that the U.S. EPA revise the preferred alternative to address a larger treatment area indicative of potential non-aqueous phase liquids to facilitate achievement of remediation goals over a shorter period of time.

The following are FWS comments (in italics) on the Proposed Plan and EPA's responses those comments:

A. The Selected Remedy must consider and protect against unacceptable risks.

The National Contingency Plan (NCP), Section 300.430(f)(1)(i)(A), requires that a remedial alternative must adequately protect human health from unacceptable risks posed by hazardous substances in order to be selected. Section 300.430 (e)(2) states that alternatives shall be developed that protect human health and the environment by eliminating, reducing, and/or controlling risks posed through each pathway by a site.

The Administrative Record upon which the remedy will be selected does not provide an adequate basis to demonstrate what the total current risks are and whether risks will be acceptable after the remediation is complete. The Focused Feasibility Study Revision 4, Plume 2 at PCB OU Site 33, April 2013 (FFS) states "soil exposure risks are limited to potential exposures to non-residential workers and construction workers" and reports that soil concentrations of TCE are below the USEPA 2011 regional screening levels (RSLs) for TCE in industrial soil. However, site data suggest this is likely not the case. This may not be a concern as the lowest RSL may not be relevant. If this is the case it needs to be clearly explained and documented. Merely stating that the 2009 remediation addressed elevated levels is insufficient. In addition, the construction (excavation) worker is not among the populations USEPA considered in developing the RSLs (USEPA FAQs for RSLs, November, 2012). Exposure to the construction worker needs to be addressed.

A risk assessment which addresses all hazardous substances likely to be associated with industrial processes at the site (for example, metals, cyanide, PCBs, polycyclic aromatic hydrocarbons, CVOCs, and dioxins) above naturally occurring levels should be completed prior to remedy selection, or the preferred alternative should be revised to ensure that it is protective under the scenario.

EPA Response to FWS Comment A:

The 1990 PCB OU ROD required the excavation and incineration of PCB-contaminated soil and sediments within the PCB OU, and required that a risk assessment be conducted to ensure that the risk from all of the chemical contaminants present above naturally-occurring site-specific background levels do not exceed an excess cancer risk of one in one million (10^{-6}) or do not produce any non-cancer chronic health effects. U.S. EPA did not include any requirement for soil-related risk assessment in this interim ROD Amendment because the 1990 PCB OU ROD already requires soil-related risk assessment and selected a protective associated soil cleanup plan. The Settling Defendant, under the terms of the 1991 Consent Decree for the PCB OU, is in

the process of complying with the soil-related risk assessment requirements including, as necessary, conducting the risk assessment for a site-specific construction worker scenario. This ROD Amendment addresses Plume 2 groundwater contamination only.

B. Model should evaluate impact of a larger area of treatment in reducing estimated cleanup timeframe.

The Proposed Plan focused on addressing the most highly contaminated area of the plume (approximately 900 square feet in plan view) for reducing the contaminant mass and the cleanup timeframe. The plume beyond the treatment area is predicted to persist at levels exceeding cleanup goals for extended periods, whether or not source area treatment occurs. The model includes estimates of the source mass (particularly the mass of non-aqueous phase liquids (NAPL), location of the source (low permeability clays, etc.) biodegradation rates, and groundwater flow rates. There is significant uncertainty associated with most of these parameters, resulting in high level of uncertainty associated with the project remedial time frames (see also comments on the groundwater model, Attachment A).

The extent of the NAPL zone based on the conclusions of the supplemental site investigation is questionable. It could extend beneath building I-1-2. As a result, the magnitude of the NAPL source that could continue to degrade groundwater may be underestimated, and the source treatment area identified in the Proposed Plan could be inadequate to achieve cleanup in the estimated timeframes. The FFS acknowledges that the "treatment of the source area indicative of NAPL would provide a significant benefit to remedy performance as compared to passive treatment alternatives. However, no additional benefit to remedy performance would arise from selection of a larger target treatment zone."

While it is true that expanding the treatment areas to include areas with no NAPL would have negligible effects, any additional NAPL removal will reduce remediation time frames. The FFS assumes 99% removal within the treatment zones (hot spot source areas) and acknowledges some residual NAPL is likely to be left behind after remediation. However, the FFS does not address the areas outside the treatment zones indicative of potential NAPL. Inclusion of NAPL zones in the model would substantially increase the projected remediation time frames. FWS requests that the uncertainty associated with the input parameters for the model be evaluated and that the time frames for remediation be presented as ranges. The precision reflected in the current time estimates is not justified by the data. Effects of residual NAPL should also be included in the time frames. Even with treatment, remedial time frames may be in the hundreds of years. FWS requests that USEPA revise the preferred alternative to address a larger treatment area indicative of potential NAPL to facilitate achievement of remediation goals over a shorter period of time.

EPA Response to FWS Comment B:

U.S. EPA has clarified in the ROD Amendment that the remedial action objective of the interim groundwater remedy is to effectively treat all locations of the Non-Aqueous Phase Liquid (NAPL) in Plume 2 of the PCB OU. Following treatment, short-term monitoring will be conducted to evaluate the effectiveness of the implemented cleanup measures. During such routine monitoring, if a new NAPL source is identified, U.S. EPA will take additional actions as appropriate.

C. Life Cycle Costs and Long-Term Monitoring

The presence of a residual DNAPL zone will make attainment of cleanup standards problematic and likely impossible. Given that current technology cannot achieve the required mass removal efficiencies within any reasonable time, the actual costs of long term monitoring may be significantly more (3 times or greater) than the capital costs. FWS requests USEPA to evaluate the alternatives based on life cycle costs over the entire project duration using a "no discounting" scenario. FWS requests the selected remedy include an explicit process and timeframe for evaluating when long term monitoring could be ended given that it is unlikely that the preferred remedy or the other alternatives will achieve Illinois Class I standards within 100 years.

Finally, because of the characteristics of this site and the remedies considered, the scope of long term monitoring should be greatly reduced. The groundwater plume is relatively stable and is likely to remain above standards for well over 100 years. The long-term monitoring will not alter this situation or achieve any specific results within any specific time frame. Realistically, the purpose of monitoring is limited to confirming that the plume is not expanding and that concentrations are decreasing. Therefore, annual monitoring for the first five years does not appear to be needed. FWS believes that a maximum monitoring frequency of five years should be adopted and, unless monitoring results indicate the plume is expanding, longer frequencies, such as 20 years should be adopted after a reasonable period of time. In addition, and for similar reasons, 14 wells (or 20, as identified in the FFS) appear unnecessary. Four wells should be adequate to accomplish the purposes of monitoring.

EPA Response to FWS Comment C:

U.S. EPA has clarified in the ROD Amendment that the selected groundwater remedy is an interim measure that will include short-term monitoring to determine the effectiveness of the interim remedy. The number of required monitoring wells will be determined during the remedial design stage and may change over time as the results of the interim groundwater remedy develop. The interim remedy does not include long-term monitoring.

U.S. Environmental Protection Agency
Remedial Action

Administrative Record Site Index
For

Crab Orchard National Wildlife Refuge
PCB Areas Operable Unit
Marion, Williamson County, Illinois

Update 8
July, 2014
SEMS ID:

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1	475454	5/16/13	Beasley, C., U.S. Fish and Wildlife Service	Gowda, N., U.S. EPA	Letter re: Proposed Plan and Administrative Record for Plume 2, PCB Areas OU (Comments on Numerical Groundwater Modeling Technical Memorandum Attached)	9
2	475455	5/17/13	Burchett, K., U.S. Fish and Wildlife Service	Gowda, N., U.S. EPA	Letter re: Proposed Plan and Administrative Record for Plume 2, PCB Areas OU	1
3	913790	9/10/13	U.S. EPA	None	Summary of Meeting for Record of Decision for the PCB Areas Operable Unit, Plume 2	7
4	913791	12/19/13	CH2M Hill	None	Summary and PowerPoint Slides for Meeting regarding Record of Decision for the PCB Areas Operable Unit, Plume 2	27
5	913792	6/16/14	Bonnett, L., Illinois Environmental Protection Agency	Gowda, N., U.S. EPA	Letter re: Illinois Environmental Protection Agency Concurrence with Interim Selected Remedy for the PCB Areas Operable Unit, Plume 2	1

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Administrative Record Site Index
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Crab Orchard National Wildlife Refuge
PCB Areas Operable Unit
Marion, Williamson County, Illinois

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1	140854	8/1/90	U.S. EPA	File	Record Of Decision (ROD) (Signed) - PCB Areas Operable Unit - Sangamo Crab Orchard	99
2	269255	7/1/99	U.S. EPA/ OSWER	U.S. EPA	A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents	184
3	140861	1/6/00	VanAllan, P., RMT Inc.	Gowda, N., U.S. EPA	Groundwater Investigation Report & Focused Feasibility Study - Sites 32/33: Part I - Groundwater Investigation Report (Rev 1) - PCB Areas Operable Unit - Vol 1 of 2	172
4	140863	1/6/00	VanAllan, P., RMT Inc.	Gowda, N., U.S. EPA	Groundwater Investigation Report & Focused Feasibility Study - Sites 32/33: Part I - Groundwater Investigation Report (Rev 1) - PCB Areas Operable Unit - Vol 2 of 2	161
5	140864	1/6/00	VanAllan, P., RMT Inc.	Gowda, N., U.S. EPA	Groundwater Investigation Report & Focused Feasibility Study - Sites 32/33: Part II - Focused Feasibility Study (Rev 1) - PCB Areas Operable Unit - Vol 1 of 1	319
6	140895	6/23/00	U.S. EPA	File	Explanation of Significant Differences (ESD) (Signed) - Sangamo/Electric - PCB Areas Operable Unit	12

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7	249401	5/1/01	RMT Inc.	U.S. EPA	Preliminary Design Report Groundwater Remedial Action (Revision 0) Crab Orchard National Wildlife Refuge PCB Areas Operable Unit - Sites 32/33 Vol 1 of 2	226
8	249402	5/1/01	RMT Inc.	U.S. EPA	Preliminary Design Report Groundwater Remedial Action (Revision 0) Crab Orchard National Wildlife Refuge PCB Areas Operable Unit - Sites 32/33 Vol 2 of 2	1662
9	249403	6/1/01	RMT Inc.	U.S. EPA	Addendum No. 1: Preliminary Design Report for Groundwater Remedial Action (Revision 0) Issued May 8, 2001	12
10	249404	8/1/01	RMT Inc.	U.S. EPA	Addendum No. 2: Preliminary Design Report for Groundwater Remedial Action (Revision 0) Issued May 8, 2001	139
11	249405	9/1/01	RMT Inc.	U.S. EPA	Addendum No. 3: Preliminary Design Report for Groundwater Remedial Action (Revision 0) Issues May 8, 2001	73
12	249407	8/1/04	RMT Inc.	U.S. EPA	Focused Feasibility Study (Revision 3) Crab Orchard National Wildlife Refuge PCB Areas Operable Unit Sites 32/33	418
13	249408	8/1/04	RMT Inc.	Public	Proposed Plan for Amendment to August 1990 ROD & June 23, 2000 ESD for PCB Areas Operable Unit	28
14	236132	9/28/06	Thorson, R., U.S. Fish & Wildlife Service	Mathur, B., U.S. EPA	Letter re: Proposed Remedy for Plume 2 at the PCB Areas Operable Unit at the Crab Orchard National Wildlife Refuge Site	2

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15	236131	10/6/06	Schafer, G., U.S. EPA	Horvath, F., U.S. Fish & Wildlife Service	Letter re: Proposed Remedy for Plume 2 at the PCB Areas Operable Unit at the Crab Orchard National Wildlife Refuge Site	2
16	236130	5/11/07	Illinois EPA	U.S. EPA	Illinois EPA Concurrence with the Revised Remedy for the PCB Areas Operable Unit at the Crab Orchard National Wildlife Refuge Site	1
17	236133	8/7/07	U.S. EPA	Public	Record of Decision Amendment for the PCB Areas Operable Unit at the Sangamo Electric Dump/ Crab Orchard National Wildlife Refuge Superfund Site	55
18	441344	4/1/13	U.S. EPA	Public	Proposed Plan to Amend the Record of Decision (August 1, 1990) for the PCB Areas Operable Unit at the Crab Orchard National Wildlife Refuge Superfund Site	24
19	902669	4/1/13	CH2M Hill Inc.	Gowda, N., U.S. EPA	Focused Feasibility Study (Revision 4) for Plume 2 at PCB Areas Operable Unit Site 33, Crab Orchard National Wildlife Refuge W/Responses to Stakeholder Comments	751